FLAX

in

WESTERN CANADA

VARIETIES
PRODUCTION
HARVESTING
& THRESHING
GRADING

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INDEX

Foreword

OF ALL THE CROPS grown in Western Canada over the years none has been subject to greater fluctuation in acreage and production than has flax.

In the early years of the present century when prairie farm lands were being settled, flaxseed was favoured because it was the only crop that could be seeded on spring breaking and still give a cash return the same year. As the growing of wheat and coarse grains took over, the interest in this crop gradually diminished... It was not until 1939, in fact, that flax began to assume some importance as a commercial crop and that Canada again became self-sufficient in the matter of linseed supplies, after being a net importer for some years. Interest in the crop was maintained throughout World War II but once more subsided. Since the mid-50's flax has again found favor with Canadian farmers and although the area seeded has recently decreased since the peak of 3 million acres was reached in 1957, it is still substantial.

Until 1962, when a new race of rust first posed a threat to some of the leading varieties grown in Western Canada, flax had been well protected against 'rust' and 'wilt'. The effect that this new rust threat will have upon flax acreage, in 1964, remains to be seen. Probably the greatest incentive to producers has been the much greater freedom of movement which flax has enjoyed market-wise. This incentive still remains. Also encouraging has been the fairly sustained overseas demand for Canadian flax at relatively good prices. All this has meant that flax has become a very important 'cash' crop for the prairie farmer.

Because flax growing calls for a somewhat different approach, many farmers accustomed to the growing of wheat and coarse grains may not feel as at home raising this crop. Yet the producer who gives it the proper attention is usually well repaid for his efforts.

It is our sincere hope that this revised bulletin, first printed in March 1958, will serve to bring together some of the more important facts not only with respect to the growing of flax but also with respect to recommended varieties, common diseases, methods of weed control, harvesting and threshing procedures and other matters of general interest to flax producers.

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WINNIPEG, MANITOBA,
APRIL, 1964.

ALTHOUGH THE PURPOSE OF THIS BULLETIN IS TO OFFER SOME GUIDANCE WITH RESPECT TO THE GROWING AND HARVESTING OF FLAX IN WESTERN CANADA, NO ACCOUNT OF THIS IMPORTANT CROP WOULD BE COMPLETE WITHOUT A BRIEF REFERENCE TO PRODUCTION TRENDS AS WELL AS TO THE CHANGING USES TO WHICH VARIOUS OIL SEED CROPS ARE BEING PUT AND THE GENERAL OUTLOOK FOR FLAX AND LINSEED OIL.

Trends in Flax Production

Because of its adaptability to varied climatic conditions, the flaxseed crop has a much wider range than that grown for fibre. Yet, although flaxseed is produced in a number of countries in many parts of the world, it is raised extensively in only a few. Thus between them, in 1963, the **U.S.A., Canada, Argentina** and **India,** produced 77.2% of the world's flaxseed. World production has shown considerable fluctuation from year to year but there is no significant trend, foreign production and overall consumption showing little tendency to expand.

THE CHANGING PRODUCTION PATTERN

The following table shows the world production of flaxseed for each of the past two seasons, as well as the average production for the 5-year pre-war period, 1935 to 1939, and, the average production for the most recent 10-year period 1954 to 1963.

World Flaxseed Production in Bushels

	Five Year Average 1935-39	1962	1963	Ten Year Average 1954-63
		— thousand bushels —		
United States	10,991	31,952	31,152	33,078
Argentina	59.571	33,015	28,345	24,710
Canada	1,508	16,042	21,176	19,798
India	19,360	17,960	16,798	15,800
Others	43,340	34,256	28,734	34,303
Total	134,770	133,225	126,205	127,658

Source: Dominion Bureau of Statistics & U.S. Department of Agriculture.

The above figures indicate very clearly the marked change in the production pattern that has come about since the late thirties. During the 40 year period 1908 to 1948, the **UNITED STATES** had imported flaxseed and during that time she had brought in just about as much as her own farmers had raised. During the 1930's, in fact, imports ran higher than production. Based on needs and experiences during World War II, a drive made to increase domestic production culminated in a record 1948 crop of close to 55 million bushels. For the past 10 years, annual U.S. outturn has continued at a level averaging close to 33 million bushels or some 5.8 million bushels above domestic requirements. Dramatically, therefore, the United States has changed over from being the world's leading importer of flaxseed to an exporter of this commodity.

CANADA'S performance has been almost as striking. During the immediate pre-war years the flax crop totalled about 1½ million bushels and the difference between this and Canada's domestic requirements was made up by imports of flaxseed principally from Argentina, although varying quantities of linseed oil were also imported. During the war, with the oil situation becoming acute, price inducements were given, acreage and production were increased and the crushing capacity of Canadian mills was expanded.

There have been some fairly wide variations in Canadian acreage and production since 1940 but flax has now become an important crop in an expanding economy and, in recent years Canada's exports have been significant. As will be seen from the table on page 2, the average production for the past 10 years has been 19.8 million bushels, an all-time record crop of 35 million bushels having been produced in 1956 on some 3 million acres. Against this level of production domestic disappearance in Canada during the past five years has averaged about 5.9 million bushels, with the average export at approximately 13 million bushels.

ARGENTINA, formerly a major producer of flax, with production between 1935-39 averaging nearly 59.6 million bushels annually, has witnessed a large decrease in production, with the average for the past ten years being close to 25 million bushels. But in recent years the level of flaxseed production in Argentina has been rising steadily.

OVERSEAS DEMAND

Most of the demand for flaxseed has come from Europe, some 82.6% of world imports from 1958 to 1962, being made by Continental countries. Moreover since European buyers prefer to do their own crushing rather than to purchase the oil, a substantial portion of the exports made from Canada and the U.S.A. have been in the form of flaxseed. Canada's share of total flaxseed exports has varied but, in 1962, it represented about 63% of the total world movement.

Flax in Competition With Synthetics & Other Oil Seed Crops

Traditionally, flax has been the chief source of oil for paints and numerous other industrial uses. However, since about 1950 the use of linseed oil has been shrinking, especially in North America. Synthetic materials have limited its use in the linoleum trade and water-base paints have sharply reduced the quantities going into paint and varnish.

New types of paint for which attractive claims have been made have caused inroads into the sales of conventional oil exterior paints. These water-base paints are now having to face competition from new linseed oil emulsion paints and some of the lost ground has been recovered, with a slight upswing in the consumption of linseed oil in evidence since 1961.

Linseed oil consumption in Western Europe has also declined. In contrast to the situation in North America, however, linseed oil continues to retain a strong place in both linoleum and paint manufacturing. Should its use in these regards shrink during the next few years to the extent it has in the United States, some new and very substantial uses for linseed oil would need to be found.

The competition that has appeared from synthetic materials and other vegetable oils does not mean the end for linseed oil, particularly in the case of outside paints where it is still supreme as an oil that withstands the elements. However, linseed oil does have certain disadvantages including a readiness to oxide or turn yellow on exposed surfaces and price-wise, too, it has to give way to cheaper oils where these can be substituted.

Other things being equal, raw materials used for paints will be those which are cheapest and in ready supply. Fortunately, a good deal of vigorous research is being done with a view to improving, if possible, the competitive position of linseed oil as a component of protective coatings. In addition, a further important outlet for linseed oil has already been found in its use for the protection of concrete surfaces against winter damage.

Undoubtedly, as research continues, wider uses will be found for linseed oil and some of the objections to it may be overcome. Other approaches that will tend to bring flax more in line with competing oil seed crops will be further increases in quality and yield and a lowering of production costs.

Flax as a Crop

Until recent years, flax was regarded in Western Canada more in the nature of a 'special' crop, rather difficult to grow and inclined to be hard on the land. More often than not, it was only grown if conditions or prices happened to be favorable or if something had occurred to prevent the planting of one of the major cereals. Many of the objections to flax, however, have disappeared and with the impetus given this crop both during and subsequent to World War II, flax now enjoys a much higher standing among farm crops and it is being grown today with a good deal more assurance and success than formerly.

The plant itself is shallow rooted and rather drouth susceptible, competing poorly with weeds and favoring a relatively cool growing season in its early stages of development. For these and other reasons, it possibly demands a higher priority in timing and in the sequence of operations than other cereal grains, including wheat.

Unfortunately, too many producers are still inclined to consider flax as a crop that may be sown at the last minute in almost any kind of soil. This is a mistake since, under such conditions, returns are likely to be very disappointing. The idea, still quite commonly held, that flax is hard on the land, has not been substantiated. All experimental evidence to-date indicates that flax does not have a detrimental effect on the soil and that it removes less of the main nutrient elements such as nitrogen, phospherous and potassium than does either wheat or oats or barley.

In the past, some of the disappointment with respect to flax and the crops that followed flax, undoubtedly stemmed from the weed problem and the fact that, until chemical spraying was possible, weeds were inclined to be more prevalent in this crop with resultant loss of moisture. Today, where good farming practices are followed, weeds are no longer a major problem and flax, vulnerable as it used to be, in this and certain other respects, is able to compete quite favorably with wheat and other cereals for a place in the cropping system on the average farm.

Flax Breeding

In the process of raising yield and quality in the flax crop, the breeder is concerned with protecting the crop against damage from a number of diseases. The most important of these are Wilt, Pasmo, Rust, and Aster Yellows. The first three are fungal diseases, while the last is caused by a virus.

Wilt has been successfully controlled by the use of resistant varieties, but control of Pasmo and Aster Yellows by this method has been more difficult to obtain. Some progress towards tolerance to Pasmo has been made in agronomically good selections. Resistance to Aster Yellows has only been found in Abyssinian varieties which are not immediately suitable for oilseed flax production in Canada.

Flax rust is an important disease, although it can be controlled by breeding, since complete immunity is available for transfer to commercial varieties. The danger with rust lies in the production of new races of the pathogen. —races which can attack currently popular varieties and build up to cause heavy losses. In such a situation, a switch to varieties resistant to the new race can rapidly reduce the incidence of the disease to a negligible amount.

The breeder has several important objectives in addition to the selection of disease-resistant types. At the same time as breeding for disease resistance, selection proceeds for yield, maturity, oil content and quality, and a determinate growth habit.

New methods have been developed which enable the plant breeder to determine lines of high oil content in very early generations where the quantity of seed is very limited. Oil content in some lines has reached 43%. Other important considerations to which the breeder is giving attention are iodine value related to drying ability, and the fatty acid composition of the oil.

Undoubtedly as time goes on, advances which have already been made will enable the plant breeder to develop varieties of flax which will be more valuable to the commercial interest as well as the farmer.

Varieties

In 1963 six varieties accounted for practically all the flax acreage in Western Canada. These varieties were:— Redwood, Marine, Redwing, Raja, Norland, Rocket. **In 1962 a new race of flax rust was found in Manitoba which attacked Cree, Arny, Sheyenne and Marine.** It is possible that these varieties may be severely damaged by this race and they can no longer be recommended. **Redwood, Raja, Norland and Rocket are resistant to this new race.**

GENERAL VARIETY RECOMMENDATIONS

MANITOBA

Marine has been the leading variety for the province, but this position may change very rapidly if the new rust damages the variety. Although rust was present on most Marine crops in 1963, it did not cause any losses. However, as a precautionary measure, and as a major step in eliminating rust in the province, Marine together with Cree, Arny, and Sheyenne have been removed from the recommended list.

For early maturity in late sowings, Raja is recommended. It should be noted, though, that Raja does not do well if seeded early in northern areas. In southern areas the later maturing varieties, Redwood and Rocket are recommended but **only if they are seeded early.**

SASKATCHEWAN

The later maturing varieties Norland, Redwood and Rocket produce good yields under most conditions and should be used for the main crop in Central and Southern areas. If seeding is delayed until June, Raja should be used. However, early seedings of Raja are often short and low in yield.

ALBERTA

Redwood is recommended for most of the south-east portion of the province while Rocket and Redwood are recommended for areas farther north. Where earlier varieties are needed in extreme northern districts, Redwing is mainly grown, although this variety is rust susceptible.

EARLY VARIETIES

RAJA: Raja is one of the earliest maturing varieties grown in Canada and yields well in late seedings. However, in northern areas it does not yield as well as Redwing and may mature later. It has an open funnel-like blue flower with large brown seeds. The smooth false septum in each cell of the boll distinguishes it from other commercial varieties. Raja is resistant to rust and flax wilt but is susceptible to pasmo. This variety was selected at the Central Experimental Farm, Ottawa, from a cross of an Argentine selection with a line selected from the fibre variety, J.W.S.

BOLLEY: Bolley was produced by the North Dakota State University Station in co-operation with the U.S. Department of Agriculture and was released as a commercial variety in the U.S.A. in the spring of 1957. It was licensed for use in Canada on February 7, 1964. Bolley is a blue flowered variety producing a brown seed. Medium in height it is very similar to Marine. In maturity it is also similar to Marine although slightly later. It is later than Raja but earlier than Redwood. The yield of this variety is similar to Marine, somewhat higher than Raja but lower than Redwood. Because of its resistance to race 300 of flax rust Bolley may be expected to replace Marine, agronomic characters being described as virtually the same in both these varieties.

LATE VARIETIES

REDWOOD: The straw of Redwood is of good length and strength. It has a blue-violet flower of medium size and brown seed of high oil content and good quality. Redwood is resistant to rust as well as to wilt and is fairly resistant to pasmo. It yields well and is recommended for all southern and central areas of the Prairie Provinces. This variety was developed from the cross Redson X C.I. 980 at the Minnesota Agricultural Experiment Station in co-operation with the United States Department of Agriculture.

ROCKET: The flower of Rocket, of medium size, is open, funnel-like and medium violet, and the seed is medium large and light brown. The oil content of the seed is high and of good quality. Rocket is resistant to rust, semi-resistant to wilt but susceptible to pasmo. It is grown to some extent in Saskatchewan but may soon be superseded by newer varieties. This variety was selected at the Central Experimental Farm, Ottawa, from a cross of Argentine 8C X Redwing.

NORLAND: Norland has a large, rather flat, white flower with blue anthers and produces brown seed. Norland is resistant to rust now common, and moderately resistant to wilt. Good yields of fair quality have been produced with Norland but it is rather later in maturity than Redwood and has not been grown extensively except in Saskatchewan. This is a selection of Victory made at the North Dakota Agricultural Experiment Station. Victory, as introduced, was a composite of strains that were irregular in both height and maturity. Norland was distributed by the University of Saskatchewan in 1954.

VARIETY YIELD PERFORMANCE

Rating Based on Co-operative Tests
(1959 to 1963 inclusive)

Black Soil Zones (Man. & Sask.)	Brown Soil Zones (Sask. & Alta.)	Black & Grey Soil Zones (Alberta)	
1. Redwood	Redwood	Redwood	1.
2. Redwing	Marine	Redwing	2.
3. Marine	Redwing	Raja	3.
4. Raja	Raja	Marine	4.

—Courtesy: Research Branch
Canada Department of Agriculture.

AVERAGE NUMBER OF DAYS TO MATURE

Based on Co-operative Tests: All Stations
(1959 to 1963 inclusive)

Variety	No. of Days To Mature
Redwood	104.0
Marine	98.3
Redwing	95.8
Raja	95.5

—Courtesy: Research Branch
Canada Department of Agriculture.

Seed and Seeding Practices

SEED

Because uniformity of ripening is important in flax, every care should be taken to see that only clean, sound, true-to-variety seed is sown. The only guarantee of such quality and performance lies in the purchase of Registered or Certified seed and particularly where a producer is growing flax for the first time or after a lapse of some years, the purchase of this class of seed is strongly recommended.

All flax intended for seed should be tested for germination, although, here again, this step is automatically taken care of if Registered or Certified seed is purchased. It goes without saying that only seed of the variety best adapted to the district and carrying resistance to existing strains of rust should be sown.

SEED TREATMENT

All flax should be treated with a suitable fungicide since, quite apart from the protection it affords against soil and seed-borne diseases, seed treatment will improve emergence.

Flax threshed under dry conditions may have as high as 50% of the seeds showing minute fractures in their coats. Also present, but more difficult to detect, are minute ruptures on the seed coats along the edges of the seed. While flaxseed injured in this way may germinate quite well in the laboratory, as soon as the seeds are planted in ordinary soil, they are subject to attack by soil borne micro-organisms which impair germination. This is why, in the case of flax, it is so important to protect the seed with a fungicide.

Flax grown in moist areas is less likely to show seed fractures although the seeds may carry seedling blight fungi which attack the seedlings at both the pre-emergent and post-emergent stages of growth.

The general practice is to treat seed with an organic mercury compound such as Ceresan, Leytosan or Panogen at the prescribed rates, efficiency of treatment depending on good coverage of the seed. Normally, seed is treated just prior to seeding operations although if conditions for storage are good and moisture content is normal, it may at times be treated several weeks ahead.

THE SEED BED

Flax grows well on any clean soil suitable for cereals — especially the heavier loams that retain moisture well. Because it is shallow rooted, however, it is rather drought susceptible and it may not thrive on sandy soils.

A proper seed bed is considered most important to secure even germination and early emergence of the small seed and to get the crop away to a good quick growth. The method of preparation will depend, to some extent, upon the previous crop and upon soil conditions.

In parts of southern Manitoba it is a fairly common practice to plough and to seed the crop with a pony press drill, all in one operation. In southern Alberta and Saskatchewan a common procedure seems to be to shallow cultivate, rod weed once or twice and then to seed into packed ground. Harrowing is often done at some stage, either prior to or after the seeding operation.

Although procedures in preparing the seed bed differ somewhat in various sections of the west depending on the type of soil, moisture conditions, etc., the general principles followed are the same. They include: shallow cultivation, packing the soil in some manner and the making of a firm seed bed to ensure that the seed is in close contact with the moisture in the soil. Despite the best efforts to prepare a good seed bed, poor emergence on account of early crusting of the soil due to heavy rains may, at times, be experienced.

In both **Saskatchewan** and **Alberta** a high percentage of the flax is seeded on summerfallow. In **Manitoba** most farmers seem convinced that flax does better on second crop land than does wheat or other grain. This, in the main, reflects efforts to secure better weed control, the claim being that, with the introduction of new herbicides, a cleaner crop can be obtained on stubble land. There is general acceptance of the fact, too, that in Manitoba the disease rhizoctonia (seedling blight) is more prevalent on flax grown on summerfallow, under the generally higher moisture conditions which exist in that province.

DATE OF SEEDING

In any given season there appears to be a definite time limit beyond which flax should not be seeded. Beyond that limit, the chance of producing a profitable crop is something of a gamble. All evidence seems to point to the fact that flax is more often planted too late rather than too early in the season. The goal, therefore, should be to seed flax as early as possible taking such factors into account as the condition of the land, the weed situation, available moisture, and the variety to be seeded.

Contrary to popular belief, flax seedlings fairly soon after emergence stand freezing about as well as small grains, and under favorable condition flax 2 to 3 inches in height has survived temperatures of 18°F. without injury. Once established, the crop thrives in cool weather and gets a head start on weeds. Thus early planting usually permits flax to complete most of its development in favorable weather before the extreme heat of July and August. Very important, too, is the fact that flax seeded early is less likely to be affected by disease and if it is affected, the injury will not be as severe.

Experiments have shown that there is usually a marked falling off in yield the later the flax crop is seeded. Moreover, growers agree that, generally speaking, early sown flax is superior not only in yield but also in the quality of the flaxseed produced. There are, however, occasions when late seeding may be justified. One of these is where drouth or excessive moisture has delayed field work unduly.

RATE OF SEEDING

Rate of seeding usually varies from 25 to 40 lbs. per acre. While a somewhat lighter rate of probably half a bushel per acre is recommended on lighter land, on heavier land a higher rate of seed is more desirable and as much as 35 to 40 lbs. per acre is sometimes used. The basic rate may be changed to suit conditions. In addition to the type of soil, some of the conditions which determine how much seed per acre to use include: size of seed, percent germination indicated, the richness or moistness of soil, whether the crop is being seeded early or late and whether the soil is weedy.

DEPTH OF SEEDING

Flax is a small seed. That is why relatively shallow seeding is so important. Tests for seeding flax at depths ranging from 1 to 4 inches show considerable variation as to emergence and strength of plants. For example, in one experiment on a heavy clay loam soil, emergence was 100% at one inch in depth; only 80% emergence at 2 inches and around 25% emergence at 3 inches. The two lower depths of seeding also showed extremely weak plants.

Fields vary in texture and compactness of soil. One of the greatest concerns of the flax grower is getting a good uniform stand and this is something to which uniform germination and emergence both contribute.

A general rule is to sow quite shallow, especially on heavy soil. If possible, flax should never be seeded much below 1 inch in depth on heavy clay soil or much below 1½ inches on light textured soils.

The Use of Fertilizer

Generally speaking, flax has shown little response to fertilizer. In Manitoba, for instance, eight experiments over a period of years have shown that 40 lbs. of ammonium phosphate 11-48-0, drilled in at seeding time, increased flax yields by an average of 1.4 bushels per acre. Calculated as a percentage increase, this is considerably less than that obtained for wheat, oats or barley. Nitrogen is the important factor in increased flax yields and a broadcast application of fertilizer to supply 40 lbs. of nitrogen per acre has shown some results on stubble and even on summerfallow under favourable conditions. It is doubtful, however, if applications over 40 lbs. of nitrogen per acre would produce a sufficiently increased yield to pay.

Authorities suggest that fertilizer placement is an important factor in so far as flax is concerned. Flax is susceptible to seed injury when fertilizer is placed in contact with the seed. While rates which can be applied safely vary with soil texture and soil moisture content, it is safe to drill small amounts of phosphorus, such as that contained in 30 to 40 lbs. of 11-48-0, with the seed.

Other recommendations regarding the use of fertilizer with flax suggest that flax sown on stubble land should not be fertilized unless moisture conditions are distinctly favourable. Also mentioned is the fact that, when broadcast,

the application of fertilizer may greatly stimulate weed growth. This however, does not necessarily mean a reduction in yield since, despite the heavier weed growth, there may still be a higher yield of flax.

Flax yields well following legume crops; in fact the flax plant does well if there is an active decomposition of fresh organic matter which releases nitrogen and minerals for the use of the growing plant. If these conditions are provided and if there is ample moisture, little is likely to be gained by the use of commercial fertilizer.

Diseases

With the increase in flax acreage in recent years, it has become important to know more about the diseases of flax. Some of these can be found every year while others appear only in certain seasons. Those caused by disease-producing organisms, seed or soil-borne, can be controlled or reduced in severity by good cultural practices, by care in the selection of the variety or by recommended seed treatments. Others which are the result of climatic conditions are beyond the control of the grower.

Elsewhere in this section there appears a short table showing the main symptoms and the usual methods that are followed in preventing or controlling the common diseases of flax. A somewhat fuller account of the main diseases (excluding 'wilt' against which protection is now afforded) is given below.

RUST

Rust is characterized by small, roundish, orange-red pustules on the leaves early in the season, and by extensive ¼ - ½" long, black pustules along the stem later in the summer. When rubbing the orange pustules the fingers become colored with the spores. Resistant varieties are an efficient control measure. Because resistant varieties have been widely grown the disease was inconspicuous until 1962. Lately, however, new rust races have appeared in the eastern prairies and hitherto resistant varieties as Marine, Arny, Cree and Sheyenne are now highly susceptible.

Flax rust, unlike cereal rust, can over-winter on infected plant residues. Proper rotation of the flax crop, therefore, is very important and care should be taken never to follow one flax crop with another. Nor should flax be planted even on adjoining fields, if it can be avoided.

SEEDLING BLIGHT

This disease may be caused by several different fungi, one of the most prominent of which is 'Rhizoctonia Solani' a soil-borne organism which attacks flax seedlings before or just after they emerge from the ground, destroying tissues at or below the soil surface and resulting in the death of seedlings. It seems to be favored by fairly warm, moist soil and to be most active in well worked land, causing greatest loss to flax sown after summerfallow.

BROWNING AND STEM BREAK

This is a fungal disease of the above-ground parts of the plant. The fungus causing it is seed borne, and lives over the winter in the open or diseased flax residues. It is not usually conspicuous until towards the end of the flowering period when the upper part of the plants may turn brown rapidly. The stems become very brittle and a proportion of the affected plants break off in the region of the first node. The disease occurs frequently in both Alberta and Saskatchewan, although it is rare in Manitoba.

Special Supplement

THE EXPERIENCE OF SOME LEADING COMMERCIAL FLAX GROWERS IN WESTERN CANADA

In an attempt to examine the whole field of flax production in Western Canada, the **Canadian Barley and Oilseeds Committee** conducted a survey, late in 1963, of some 220 selected flax growers in many of the major flax growing districts throughout Manitoba, Saskatchewan and Alberta.

The following facts and comments are taken from a summary of the survey, presented at the Canadian Barley and Oilseeds Conference, Winnipeg, February 14, 1964.

With the kind permission of The Committee, they are being included in this text for the reason that they reflect the practices and the experience of some of the leading commercial growers of flax who have enjoyed a considerable measure of success in raising this crop. At the same time they probably give a fairly good indication of the procedures being followed generally in each of the Prairie Provinces.

GENERAL

SELECTED COMMENTS

ALBERTA

Standard: In my experience flax has never brought less cash per acre than wheat, although sometimes equal. In the dry years 1960 and 1961 flax yielded the same or better than wheat in bushels per acre.

Beaverlodge: Flax is the best producing crop on grass sod. It produces well and allows the grass to re-establish.

Watino: On the average, flax returns as much as any other crop as long as the price stays around $3.00 per bushel.

SASKATCHEWAN

Beechy: I find that flax takes less moisture and is a challenging crop to grow.

Pasqua: I believe flax is the hardiest cereal that we grow, withstanding more frost, drought and wet weather.

Rouleau: The flax crop is in all respects critical, demanding, frustrating and uncertain. Unless one can give it much better than average care and attention it is better to stick to wheat.

MANITOBA

Goodlands: For a number of years I grew flax on summerfallow and followed it with malting barley. But recently, due to difficulty in obtaining 'malting' for our barley, I have changed to wheat on summerfallow and flax as second crop.

Waskada: Flax seems to produce a better cash crop on second crop land compared to other grains. It has been found that a better crop is produced on summerfallow after flax rather than on summerfallow after hard wheat.

Elm Creek: During the last couple of late springs, flax has been the only worthwhile crop we've had to harvest. On the average, cash return is about the same as wheat.

Deloraine: Find flax a better late crop than barley.

Arborg: With the introduction of the new herbicides flax will give a better cash return on stubble fields than wheat or other cereals.

PRODUCTION PRACTICES

Q. Do you follow any definite rotation system which includes flax?

	Indicated Practice (By Province)		
	Alta.	Sask.	Man.
Yes	57.4%	54.5%	76.1%
No	42.6%	45.5%	23.9%

SOME TYPICAL ROTATIONS FOLLOWED

Alberta

(Southern and Central Regions)

- Summerfallow - Flax - Wheat
- Summerfallow - Flax - Wheat - Summerfallow - Wheat
- Summerfallow - Flax - Summerfallow - Wheat
- Wheat, Oats or Barley - Flax - Wheat - Summerfallow
- Wheat - Flax - Barley - Summerfallow

(Peace River Territory)

- 1/Breaking - Flax - Barley or Wheat

1/ Native sod or land in grass or clover broken up the previous year—usually in the fall.

Saskatchewan

- Summerfallow - Flax - Wheat
- Summerfallow - Flax - Durum Wheat
- Summerfallow - Flax - Barley or Wheat
- Summerfallow - Flax - Barley
- Summerfallow - Flax - Wheat - Summerfallow - Wheat - Wheat
- Wheat - Flax - Summerfallow
- Rye or Wheat - Flax - Summerfallow

Manitoba

- 2/Wheat - Flax - Summerfallow
- Wheat - Flax - Oats - Summerfallow
- Wheat - Flax - Wheat
- Wheat or Summerfallow - Flax
- Oats - Flax - Wheat
- Oats - Flax - Summerfallow - Wheat
- Sunflowers - Flax - Summerfallow - Wheat
- Wheat - Flax - Summerfallow - Sugar Beets
- Summerfallow - Flax - Barley - Oats
- Summerfallow - Flax - Oats

2/ One of the most common rotation systems followed.

Q. As a rule do you seed flax on summerfallow or stubble?

	Indicated Practice (By Province)		
	Alta.	Sask.	Man.
On fallow	72.1%	55.0%	6.5%
On stubble	8.2%	30.0%	84.8%
On both fallow and stubble	6.7%	15.0%	8.7%
On breaking	13.0%	.....	.....

Q. Do you generally seed your flax early or late in the season?

	Indicated Practice (By Province)		
	Alta.	Sask.	Man.
Early (to end of May)	79.7%	78.3%	34.9%
Late (after June 1st)	11.9%	16.7%	47.7%
3/Range of dates	8.4%	5.0%	17.4%

3/ Falling in both early and late periods.

Q. Do you fertilize your flax crop?

	Indicated Practice (By Province)		
	Alta.	Sask.	Man.
Yes	39.0%	20.7%	11.1%
No	57.6%	75.9%	76.7%
Experimental basis only	3.4%	3.4%	12.2%

Q. Have you had any response from the use of fertilizer on flax?

	Indicated Response (By Province)		
	Alta.	Sask.	Man.
Yes	73.9%	57.2%	47.6%
No	26.1%	21.4%	47.6%
No close check	.....	21.4%	4.8%

Yes denotes producers who were quite definite about there having been a favourable response as well as many who felt that, while the yield response was not pronounced, there were advantages to using commercial fertilizer on flax. These included promotion of earlier ripening, quicker germination, etc.

No denotes those who had experienced no advantage from the use of fertilizers on flax or saw little evidence of response.

SELECTED COMMENTS

ALBERTA

Brant: No one-ways used under any consideration. All cultivation done with heavy duty cultivator and Noble blade. Also cultivate at better than average depth.

Milo: I blade early in the spring. Just prior to seeding, flax land is rod weeded. Flax seeded with discer. I try to rotate so as not to grow flax on same land for at least five years.

Vulcan: Very firm shallow seedbed is needed. The sooner emergence takes place the better chance flax has. Have never seeded flax on same land more than once in four years.

Barons: In spring we work the land shallow pulling packer behind whatever implement we use. Seeding is done as shallowly as possible.

Lethbridge: Use cultivator first at 2 to 3 inches with packer. Then rod weed later — then rod weed again — then seed right away in packed ground.

Standard: Shallow cultivation in summerfallow year. In year of seeding, shallow cultivate followed by rod weeding and packing ahead of the drills.

Granum: Always seed flax on summerfallow. Keep the weeds down to conserve moisture but do not work too much on account of drifting.

Beaverlodge: Main thing is to pack the ground well. Seed with press drill and then pack with land packers. This ensures even germination and quick growth.

Blackie: Spring tooth harrows and rod weed. The rods are used until the soil is firm then flax is sown with press drill. Noble blade used for summerfallowing.

SASKATCHEWAN

Davidson: I farm on half summerfallow basis and work my flax land (to be seeded) first thing in the spring with cultivator and rod weeder, or harrow. Later I rod weed and seed.

Gravelbourg: I pass the discer with harrows behind and then I seed with press drill and harrow, after which I harrow again.

Moose Jaw: Use a discer with packer attached to prepare seedbed, and then, in about one week, rod weed on the angle to finish weeds, pack and level land — seed with hoe drill.

Beechy: Cultivate with rod weeder first thing in the spring then leave two weeks. Repeat rod weeding just prior to seeding. Seed with discer then harrow and pack.

Lacadena: Rod weed ahead of seeding to eliminate wild oats and make firm seedbed.

Dodsland: Flax needs a firm seedbed; that is why stubble is more suited than summerfallow. If I seed on summerfallow, I use a rod weeder as much as possible.

Pasqua: If sowing flax on wheat stubble, I just hoe press straight in. The less disturbance of soil the less the weed problem, particularly in the case of wild oats. Since Avadex is available, have been seeding on summerfallow.

Webb: I have a bigger problem summerfallowing flax ground and there is a greater weed problem.

MANITOBA

Killarney: Use cultivator and one-way but also harrow to preserve moisture. Important to get a quick start.

Portage: Cultivate about May 20th, leave same for growth and then shallow disc at time of seeding. This method has been very satisfactory in controlling weeds and wild oats.

Elm Creek: Work land as early as possible with a discer then leave a couple of weeks if weather is right. Then cultivate and seed.

Melita: I seed flax from the start of seeding and carry right through until the end of seeding. Spring plough and pack, followed by press seeder. Summerfallow or fall ploughing intended for flax is disced lightly and packed followed by press seeder.

Sanford: Work land early, not too deep, and let lay for two to three weeks then seed into moisture to obtain even germination.

Boissevain: I fall plough, cultivate and pack in spring and cross harrow prior to seeding. I find fall ploughing controls wild millet better than surface cultivation.

SEED AND SEEDING PRACTICES

Q. Do you purchase fresh seed stocks regularly?

	Indicated Practice (By Province)		
	Alta.	Sask.	Man.
Yes	70.0%	88.1%	81.6%
No	30.0%	11.9%	18.4%

Class of Seed Purchased

	Indicated Practice (By Province)		
	Alta.	Sask.	Man.
Registered or Certified	66.7%	84.6%	73.2%
Commercial from Neighbour	9.5%	.....	5.6%
Commercial through trade channels	7.1%	1.9%	8.5%
Regt., Cert. or Commercial — trade channels	16.7%	13.5%	12.7%

Q. Where do you clean your flax for seed?

	Indicated Place of Cleaning (By Province)		
	Alta.	Sask.	Man.
On farm	25.4%	41.1%	54.9%
At local elevator	.....	1.8%	2.2%
At seed cleaning plant	74.6%	57.1%	42.9%

Q. Do you always treat your seed flax?

	Indicated Practice (By Province)		
	Alta.	Sask.	Man.
Yes	82.0%	78.3%	41.3%
No	16.4%	18.3%	56.3%
Sometimes	1.6%	3.4%	2.2%

SELECTED COMMENTS

ALBERTA

Standard: I find a rate of 30 - 35 lbs. of large seeded flax (Raja) is ample. Any more only produces spindly plants which are hard to cut.

SASKATCHEWAN

Yellow Grass: If seeding with drill or hoe drill, we seed less. Seed heavier with discer and when using Avadex.

Leader: We clean our seed using two Forever Cleaners and thence through a double Carter disc. Seeding rate is increased somewhat if discer used, especially on summerfallow.

MANITOBA

Boissevain: I seed at 50 lbs. Prefer heavier seeding rate if moisture is plentiful.

Domain: Have found that with early seeding on breaking (approximately May 20th) a lesser seeding rate (approximately 25 lbs.) can be used with good results. Plants seem to stool better and to produce a better yield of flax bolls.

Graysville: Find it better to seed on the light side.

WEED AND WEED CONTROL

Q. Do you find weeds to be a problem in the raising of flax?

	Indicated Experience (By Province)		
	Alta.	Sask.	Man.
Yes	70.5%	63.3%	66.7%
No	29.5%	36.7%	33.3%

Q. What weeds are most troublesome?

Indicated Severity of Weeds
(In order of importance)

Alberta

Russian Thistle
Wild Oats
Red Root Pigweed
Stinkweed
Wild Buckwheat & others

Saskatchewan

Wild Oats
Russian Thistle
Lady's Thumb
Wild Buckwheat
Wild Mustard & others

Manitoba

Wild Millet
Lady's Thumb
Wild Oats
Red Root Pigweed
Wild Mustard & others

SELECTED COMMENTS

ALBERTA

Brant: My own tests to-date have proved that Ester does the best job on flax and nets me the best final yield.

Standard: Buckwheat is very troublesome and, if it remains uncontrollable, my flax acreage will have to be cut in future.

Beaverlodge: Have had great success in spraying for weeds with MCP, also using Avadex for wild oat control. Blue Burr survives the spraying but is generally more of a nuisance, not causing much damage to the crop.

Acadia Valley: Flax must be sprayed at the right time. In my opinion the best stage to spray flax is at one inch in height rather than at the 2 inches recommended. Also early morning spraying best.

Vulcan: The season has quite a bearing on weeds in flax. Russian Thistle is, I think, the most resistant of any weed we have here, developing after the time to spray is past.

Barons: None of the herbicides are satisfactory for weed control in flax, but they are better than nothing at all. In killing weeds there is too much danger of damage to the flax plant.

Carmangay: When it is possible to seed flax soon after a rain so that it gets ahead of the weeds, I recommend no spraying. If no rain follows soon after spraying, I find that spraying will retard growth for 2 - 3 weeks.

Nobleford: We try to seed to get ahead of the weeds so that, if possible we can avoid spraying.

Champion: The greatest need is a suitable herbicide for "hard to kill" weeds.

Barons: We require a selective herbicide that does not damage or retard the growth of flax plants.

SASKATCHEWAN

Craik: Believe it is impossible to grow flax successfully without chemical weed control. However, setback to the crop is too severe under present methods of spraying. More research needed to reduce the hazard.

Dinsmore: Have found straight 2,4-D better to spray with than Amine. Use 3 oz. spraying early when flax about 2" high.

Webb: Summerfallow that has been well taken care of in previous years is the greatest asset in control of weeds in flax. One should not depend on herbicides alone.

Leader: Aerial spraying with 2 oz. Ester

is more satisfactory than land spraying with recommended rates of Amine or MCP. Find it best not to spray fields unless quite badly infested with weeds.

Wadena: If flax is seeded on clean land, usually no herbicides are needed.

Liberty: Only the really susceptible weeds can be controlled without serious damage to the flax crop.

Stranraer: I have had problems with Yellow Mustard, Pigweed and Russian Thistle. If it wasn't for chemical sprays, I don't think I could grow flax.

Unity: In spite of herbicides, wild oats still pose a problem.

Aylsham: Needed: a chemical that will successfully handle 'lady's thumb' without serious damage to flax.

MANITOBA

Goodlands: Weed problems vary from year to year. Usually we have more trouble with weeds when flax is sown on summerfallow than when it is sown as a second crop.

Elm Creek: Ours is heavy land and if our flax is sown before the ground and weather is warm, weeds can be a real problem. A herbicide that will kill 'lady's thumb' is the one big thing we need here.

Waskada: Wild Millet is a problem in flax, but it can be controlled with TCA.

Arborg: With the introduction of herbicides, flax can be seeded on fairly weedy land and used as a clean up crop. Find buckwheat and lady's thumb fairly resistant to 2,4-D. Buckwheat is our main problem.

Dominion City: Some weeds are difficult to control on account of crop being susceptible to the chemical if it is used in sufficient strength to kill the weeds.

Fannystelle: Care has to be taken as to dosage and stage of growth as chemical may retard growth for a period of up to 15 days.

Letellier: The use of herbicides cannot be depended on all the time on account of weather conditions which may not permit spraying at the proper stage.

Portage: Would advise not to spray for weeds in flax unless you have to. Use MCP sodium salt where I feel spraying is necessary.

St. Pierre: With heavy seeding, the chance of weeds taking over is smaller. In this way spraying does not have to be done every year. There are also fewer weeds on second crop than on summerfallow.

Sanford: I contend that the wetter the ground is when you are forced to work it, the more likely you are to have lady's thumb.

Sperling: Have not found it necessary to spray for weeds in flax for the past three years.

Winkler: Green Foxtail is a problem on lighter soils, if we get a heavy rain after seeding.

Elphinstone: With weed sprays flax is one of the easiest crops to grow free of weeds.

Oakville: Research is needed into more effective control of lady's thumb and wild millet.

HARVESTING, MARKETING AND STORAGE

Q. What is your main problem in connection with the marketing of the flax crop?

Replies to this question were very similar from all three provinces. Mentioned were:

1. Lack of steady or stabilized prices.
2. Quota restrictions and slow moving quotas.

Reference was also made to dockage and storage problems although these seemed to be less important.

Q. How do you normally harvest your flax crop?

	Indicated Practice (By Province)		
	Alta.	Sask.	Man.
Windrow & combine pickup	62.7%	35.0%	83.7%
Straight combine	30.5%	45.0%	7.6%
Both	6.8%	20.0%	8.7%

Q. At what period of the year do you usually market your flax?

	Indicated Practice (By Province)		
	Alta.	Sask.	Man.
Mainly early part of season	18.0%	15.0%	38.0%
Subsequent to January 1st	27.9%	28.3%	18.5%
Evenly throughout the year	47.6%	51.7%	41.0%
1/Other	6.5%	5.0%	2.5%

1/ Includes: In line with quotas, when price is satisfactory, registered seed sales, etc.

Q. Have you experienced degrading problems as a result of inseparable weed seeds such as lady's thumb (smartweed) etc.?

	Indicated Experience (By Province)		
	Alta.	Sask.	Man.
Yes	8.5%	8.3%	19.6%
No	91.5%	91.7%	80.4%

Q. Have you experienced any other problems with respect to the grading of flax?

	Indicated Experience (By Province)		
	Alta.	Sask.	Man.
Yes	11.4%	9.3%	28.8%
No	88.6%	90.7%	71.2%

Q. Have you experienced any storage problems in connection with flax?

	Indicated Experience (By Province)		
	Alta.	Sask.	Man.
Yes	6.8%	8.5%	9.0%
No	93.2%	91.5%	91.0%

SELECTED COMMENTS

ALBERTA

Turin: I usually straight combine because of the wind problem in our area.

Blackie: If flax ripens unevenly, windrow methods are used in harvesting.

Granum: Depends on the season whether I swath or straight combine.

SASKATCHEWAN

Cabri: Main problem with regard to marketing of flax — fluctuating prices.

Craik: It is essential to have first class farm storage—must be moisture proof.

Pasqua: I always straight combine flax. There is no loss from cutter bar, windrow or weather. Have combined with snow on the ground with no problems. I always hold flax until the market nets $3.10 or better which it will, even if one pays storage most of a year.

Kyle: Use small waterproof granaries to store flax. This reduces pressure. The higher the pressure the less moisture it takes to start if spoiling.

Leader: In the past we employed windrow and pick up operations but finally abandoned this procedure due to rolling flax swaths because of wind shortly after swathing.

Codette: Regardless of dry condition of flax when stored, it should be checked regularly.

MANITOBA

Goodlands: Have found swather and pick-up more satisfactory than straight combining because crop can often be harvested a month earlier.

Killarney: Prefer to swath and then combine. Second growth is a big problem in straight combining.

Letellier: If the crop is swathed, some sort of packer or roller is attached to pack down the swath to prevent "bunching" by high winds.

Sanford: Find marketing flax early the only way to obtain enough money to cover operations. Do not find any advantage in waiting, or holding on storage if quota is open for deliveries.

Winkler: If crop is ready for harvesting about September 20th, I swath to speed up drying but if later than this, I prefer straight combining.

MISCELLANEOUS

Q. Do you consider that flax is hard on the land?

	Indicated Experience (By Province)		
	Alta.	Sask.	Man.
Yes	36.7%	37.3%	8.8%
No	60.0%	62.7%	91.2%
Sometimes	3.3%		

Q. What is your main problem in connection with the growing of the flax crop?

Indicated Experience

(In order of importance)

ALBERTA AND SASKATCHEWAN

1. Control of weeds.
2. Lack of stubble and trash cover for following crop and danger of soil drifting.
3. Moisture (at seeding time and critical periods during season).
4. Getting proper seedbed and even germination.
5. Poor emergence on account of early crusting of soil due to heavy rains.

MANITOBA

1. Control of weeds.
2. Getting proper seedbed and even germination.
3. Moisture (at seeding time and critical periods during growing season).
4. Poor emergence on account of early crusting of soil due to heavy rains.
5. Lack of stubble and trash cover for following crops and danger of soil drifting.

Also mentioned, in all three provinces, were harvesting problems as follows:

(a) heavy winds moving swaths
(b) difficulty harvesting crop dry
(c) cutting and threshing problems
(d) getting rid of straw
(e) late or early frosts.

Q. Do you grow flax:

(a) Because it is a cash crop that can be seeded fairly late in the season?
(b) Because you usually secure a better cash return per acre on flax compared to wheat? Compared to other cereals?
(c) Because of more favourable opportunities to deliver flax under the delivery quota system?

The largest number of producers in all three provinces cited (c), or better delivery prices, as the main reason they continue to grow flax. However, a good many gave (a) or (b) as reasons, as well.

The advantages which flax offered as a cash crop for late seeding was considered greatest in Manitoba, and of less importance in Saskatchewan and Alberta.

Quite a number in all three provinces felt that flax gave a better cash return per acre compared to wheat, while others felt that the cash return for flax was generally better than that for other cereal crops.

Further reasons given for the growing of flax included:— the better distribution of farm work over the season; the smaller volume involved in the storage, handling, etc., of flax compared with other cereals and the fact that, in certain years, when other cereals were a near failure, the flax crop often turned out quite well — that is to say, it was a form of insurance.

Q. Have you experienced a serious disease problem with your flax crop?

	Indicated Experience (By Province)		
	Alta.	Sask.	Man.
Yes	5.4%	14.6%	55.8%
No	94.6%	83.6%	28.6%
One year only		1.8%	15.6%

Q. Is there any special flax production problem which, in your opinion, requires more extensive research?

The three areas of flax production in which more extensive research was suggested were:—

1. Safer and more effective herbicides for better weed control.
2. Earlier maturing varieties.
3. Higher yielding varieties.

(In the case of Manitoba, the development of disease resistant varieties was also considered important.)

Other items mentioned were:

1. Need for longer straw — to facilitate cutting.
2. Need for more precise information respecting use of fertilizers.

PASMO

This disease, caused by a parasitic fungus, has been found in Manitoba since 1940 and in Saskatchewan since 1946, although it has made little headway yet in Alberta. The disease resembles 'stem break' in several respects, although it does not tend to make affected stems break over near the ground line. The disease causes yellow brown mottled areas on the leaves, stem and seed capsules resulting in pre-mature ripening of the plants. It is more easily recognized as the plants approach maturity when irregular brown areas on the stem alternate with bands of green.

Diseased plants generally occur in groups causing brown patches to show up in affected fields and these patches may enlarge to include the whole field. Pasmo is carried through the winter on the seed and on the straw and stubble on the field. Practically all the common varieties of flax are susceptible to this disease in varying degree although some show moderate resistance. Conditions which favor rust seem to favor pasmo except that it is worse in warm, moist seasons.

HEAT CANKER

While this disease can be found in some prairie flax fields in most seasons, it is only occasionally severe. Unlike many of the other diseases it is not caused by an organism but is a result of weather conditions. It occurs when young flax seedlings are exposed to excessive heat at the soil line, the tender tissues which feed the roots becoming damaged. If the damage is severe, seedlings will fall over and die. If less severe, food accumulates in the stem above the injured area causing them to enlarge or "canker". Seedlings in thin stands on light soil are most subject to injury from this disease. The disease usually occurs when the plants are less than 6 inches in height, although plants damaged earlier may survive only flowering.

ASTER YELLOWS

This disease was first recognized as being fairly widespread on flax in farm fields in 1953. During 1957, it was widely prevalent and quite destructive in Manitoba and present, though less destructive, in both Saskatchewan and Alberta. It may become less important or even disappear if there is a series of years unfavorable to the weed hosts of the virus and the leaf hopper that carries it. Symptoms include yellowing of the upper part of the plant and distortion of the flowers. The petals may be greenish purple instead of blue and may remain on the plant instead of falling a few hours after the flowers open as they do on normal plants.

The most typical symptom is the occurrence of green to yellowish or purple leaf-like structures in place of the usual petals and other flower parts. On some plants, all flowers may be affected; on others only some flowers. The severity of symptoms depends on the stage at which plants are affected. If they are very young, they may be stunted and produce no flowers at all. Infection a little later may cause distortion and sterility of all or most of the flowers, although the plants may reach normal size. Later still, infection may cause symptoms on only some of the flowers. Where infection is too late to bring about abnormalities in the flower, the seed size and weight may be reduced. Frequently seeds produced on plants affected by this disease do not germinate.

DISEASES OF FLAX

	NATURE OF DISEASE AND SYMPTOMS	PREVENTION or CONTROL
SEED OR SOIL BORNE		
Root Rot	An adult plant symptom caused by some of the same organisms as those responsible for wilt. Plants show slight stunting with premature ripening of the plant and shrivelling of the seed.	Treat seed with recommended chemical.
Seedling Blight and Damping Off	Caused by several different fungi. Seedlings may fail to emerge. Seedlings 1 to 4 inches high wilt and die. Reddish brown patches are found on roots and stems below the soil.	Sow only sound clean seed. Sow early and shallow. Seed should be treated with recommended chemical.
Seed Rot	Caused by fungi which attack cracked seed or seed which has suffered mechanical injury. This disease comes close to being a pre-emergence seedling blight.	Sow only sound clean seed and treat with recommended chemical.
Wilt	Plants may wilt, die and turn brown at any time from the seedling stage on. The top of the stem curves down. In some cases, growth stops and the plant turns yellow or greyish in colour.	Use resistant varieties and follow a suitable crop rotation.
SEED BORNE OR CARRIED ON FLAX RESIDUES		
Browning and Stem Break	Affects the flax plant above ground, usually towards end of the flowering period. Upper part of plants turn brown with brown spots appearing on seed stems and seed bolls. Stems become brittle and a breaking over of the plants about 1 inch above ground level is apparent.	The use of clean seed in soil free from and well removed from diseased flax straws. Do not sow flax after flax.
Pasmo	Resembles browning in some respects and occurs late in season. Irregular brown spots appear on leaves and bolls. Large brown patches on stems often alternate with green areas giving mottled appearance.	Avoid the most susceptible varieties. Sow early and do not follow flax with flax.

AIR BORNE AND CARRIED ON FLAX RESIDUES

Rust	Small round orange pustules appear on leaves, especially the lower ones, and in severe cases the leaves fall. Elongate black pustules appear on the stems as plants mature.	Sow resistant varieties. Practice crop rotation so as to avoid following flax with flax. Early seeding may help to reduce injury.

INSECT BORNE

Aster Yellows	Symptoms include yellowing of the upper part of the plant and distortion of the flowers. Petals may be greenish purple instead of blue and may remain on plant. Typical symptom is the occurrence of green to yellowish or purple leaf-like structures in place of the usual petals and other parts. Severity of symptoms depends on stage at which plants are affected. If young, they may be stunted and produce no flowers at all. Later infection may cause distortion and sterility of all or most of the flowers, although the plants may attain normal size. Still later, only some of the flowers may be infected.	As this disease is carried by an insect, not much can be done about it. Weeds in and near flax crops, however, should be destroyed since some of these may carry the same virus that attacks flax.

PHYSIOLOGICAL

Heat Canker	A direct result of high temperatures at the soil line. Outer tissues of affected plants collapse and the plants fall over and die. Generally occurs when plants are 5 to 6 inches high. Partially affected plants often continue to grow but are constricted at or near the soil surface and cracks or "cankers" will appear above the injured area.	Early seeding at a fairly heavy rate in a north and south direction, to provide shade at mid-day.
Top Die-Back	Usually top third but sometimes the whole plant turns brown following hot dry weather during the ripening period.	Early seeding to mature crop earlier and to prevent heat damage late in summer, may help.

Weed Control

GENERAL COMMENTS

Flax is much less able to compete with weeds than are wheat, oats and barley due mainly to the fact that the flax plant does not shade the ground to the same extent during the growing season. The flax plant, too, has a less vigorous and extensive root system and cannot make as efficient use of plant food and moisture within its area of growth. For these reasons, the most fertile, as well as the **cleanest possible land** should be provided for this crop if satisfactory yields are to be obtained.

If the land is clean, maximum yields will be secured from early seeding but in cases where it is necessary to delay planting to permit Spring tillage for wild oat control, early maturing varieties should be used.

FLAX ON SUMMERFALLOW AND STUBBLE LAND

Land that has been inter-tilled the previous year usually presents less of a weed problem and produces satisfactory crops of flax. Summerfallow on which moisture has been conserved is generally the most productive land. There is, however, a danger that where summerfallow has been poorly worked, many weed seeds such as mustard, stinkweed and lamb's quarters will lie dormant and germinate the following year. Flax being a poor weed competitor does not outgrow these weeds as do wheat, oats and barley; this is the reason that flax grown on summerfallow is often a weedy crop. If on the other hand, weeds have been readily controlled, summerfallow is probably the best place for flax because the land will contain more moisture.

Land that has produced a grain crop the year before, if lightly worked to make a seedbed, is often much more free of weeds than is summerfallow. Where flax is sown on stubble land a recommended practice has been to disk the land lightly in the fall soon after harvest, unless there is danger of soil drifting. This operation tends to start many weeds at that time. Where no fall cultivation has been done, the land can be disked early in the Spring, two to three weeks being allowed for the weeds to make a good start and the seeding of flax being delayed until towards the end of May.

CHEMICAL CONTROL

Although 2,4-D was once included along with MCPA for the treatment of broad leaved weeds in flax, it has been shown to be considerably harder on the flax crop and it is, therefore, no longer recommended. For Russian thistle control, however, 2,4-D is the preferred treatment at rates not less than 9 ounces per acre.

MCPA is now generally used for the control of broad leaved weeds in flax, recommended rates in water spray for post-emergent control, being as follows.

OUNCES ACID EQUIVALENT PER ACRE

Formulation	Susceptible Annuals	Moderately Susceptible	Moderately Resistant	Double Application
MCPA				
Ester	4 to 6	6 to 8	(9 to 12)	5 + 5
Amine	5 to 7	7 to 9	(10 to 14)	6 + 6
Sodium Salt	6 to 8	8 to 10	(11 to 15)	7 + 7

Footnote

Under certain conditions the higher rates (in brackets) may cause injury to the flax crop, but this will frequently be offset by obtaining a higher relative yield from a less weedy crop.

For best results spraying should be done early. Treatment may be safely carried out from the time plants reach a height of about 2 inches (or the three leaf stage) up to just before the pre-bud stage. Severe injury will occur if flax is treated after buds have formed. Some delay in crop maturity can occur if spraying is not done at the recommended crop growth stage. Using high volumes of water (15 to 20 gallons per acre) will reduce this chemical effect.

Green Foxtail Control

Used in the control of green foxtail are either **TCA** or **Dalapon.** Both these chemicals must be thoroughly mixed in the sprayer before application, continuous agitation for 10 to 15 minutes being recommended. Application in either case should be made before the foxtail reaches the three leaf stage.

TCA should be applied at the rate of 4 to 6 pounds per acre either alone or in combination with recommended rates of MCPA, when broad leaved weeds are present.

Dalapon should be applied at the rate of three-quarters to one pound per acre. Special care being exercised in measuring. Over-lapping when spraying should be avoided. As in the case of TCA, Dalapon may be combined with MCPA to control broad leaved annuals as well.

Wild Oat Control

The value of wild oat herbicides will be enhanced by tillage practices which promote maximum germination.

Two herbicides are now generally used in the control of wild oats in flax. These are:— **Avadex** and **Carbyne.** Of the two, Avadex is generally favoured being very highly tolerant to flax and providing a longer period of control. Carbyne, though useful, will control wild oats only in a very specific stage of growth.

Avadex recommended rate for use in flax is 1½ pounds per acre applied as a pre-planting treatment in not less than 5 gallons of water per acre. Avadex should be mixed into the soil to a depth of not more than 3 inches immediately after spraying, using a disc type implement. Two disc operations are suggested if the soil is wet and cloddy or trash cover is heavy. The lower rate is suggested for use on summerfallow.

Carbyne should be applied at 4 to 5 ounces per acre after emergence of the flax crop and wild oats. Application should be made when the majority of the wild oats are in the 1½ to 2 leaf stage (4 to 9 days after emergence). Timing is important as the degree of control decreases rapidly when application is made prior to or following this period of growth. Carbyne should be applied with low volume (4 gallons per acre) and higher pressures (at least 45 psi.)

The lower recommended rate should be used only when soil moisture, fertility and temperature are conducive to good crop and weed growth. The higher recommended rates should be used when heavy wild oat infestations are encountered (100 or more per square yard) and when the crop is suppressed in growth because of inadequate moisture, low soil fertility or other adverse growing conditions.

Harvesting and Threshing

Flax should be cut when the greatest possible ripening has been obtained. In wet seasons or when fields have been sown late, second growth is a problem and plants will continue to bloom until well into the fall. Under these circumstances it is a matter of judgement as to when the largest amount of ripe seed may be obtained. Experience has shown, however, that more often a better crop will be harvested reasonably early in the ripening season than towards the end of the season. As yet, the use of chemical desiccants to hasten maturity and the drying of the stems has not developed to the point where it is feasible, but this is a future possibility.

Although windrowing and use of the pickup on the combine is the most familiar method of handling flax, it may be straight combined, if it is well matured and has ripened evenly. It is a fairly common practice to harvest flax after a frost which tends to dry up the plants and weeds and also hardens the flax bolls so that they are more easily shattered. This practice will depend upon fall conditions as well as upon the cleanness of the crop. It may, however, at times, be a risky procedure, especially if it is necessary to wait until late in the fall for a killing frost to occur.

WINDROWING

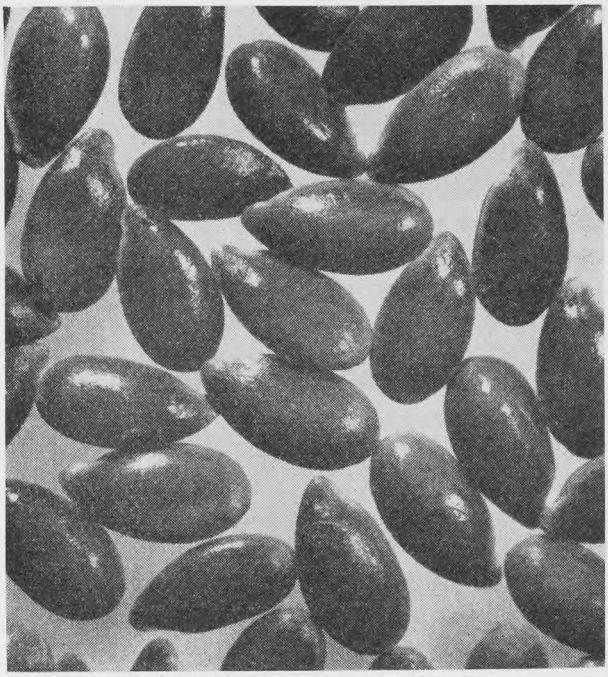
If harvested before a frost, particularly if the crop is weedy, flax usually requires windrowing to dry the flax plants, bolls and weeds, the accepted practice being to swath when 75% or better of the bolls are mature. When the crop is swathed, several precautions should be taken to make as effective a job as possible. Green, immature flax straw may give trouble in collecting under the knife and when this happens the use of a smooth-sectioned knife will usually overcome the trouble.

Flax windrows are easily blown by high winds and this problem may be overcome by trailing a light windrow packer behind the swather. Very satisfactory for this purpose is a metal float or a one-half inch pipe axle centered in a light gauge oil drum and fitted into a wooden frame to form a hitch. The weight of the oil drum packer rolling on the windrow will depress the flax into the stubble sufficiently to prevent wind damage provided the wind is not blowing at the time.

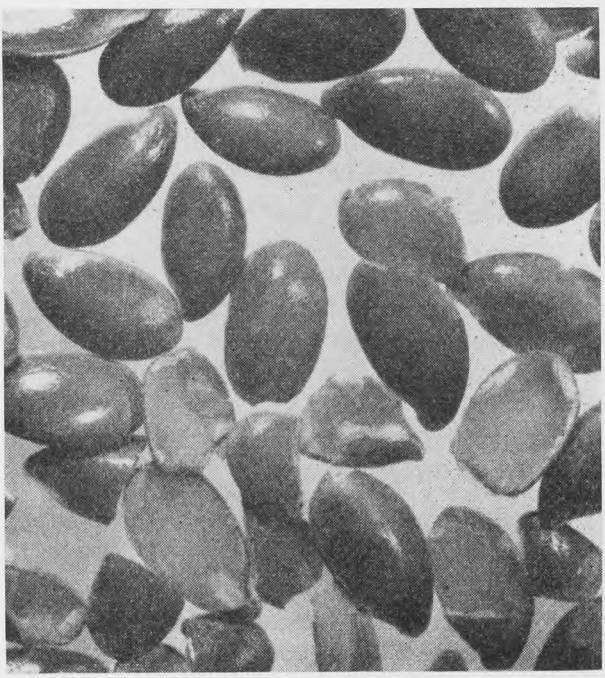
The height of cutting with a swather will vary with the height of the crop but in a crop of average height, leaving one-third as stubble and two-thirds in the windrow is recommended, although in shorter or thinner stands less stubble will have to be left so that the crop may be handled by the pickup. Generally speaking, a 4 to 6 inch height of cut provides sufficient stubble to hold flax windrows off the ground. Windrowed flax, as a rule, will retain its brightness and colour after wheat, oats and barley have become badly bleached and discoloured.

COMBINING

If free from weeds and mature, flax makes a good straight combine crop because it does not shatter easily. The seed is enclosed in tight bolls and since



Sound Flax, Well-Matured and Uniform. Grading 1 C.W.



Well-Matured Flax degraded on account of broken and damaged kernels.

—Courtesy Board of Grain Commissioners, Grain Research Laboratory, Winnipeg.

it does not sprout readily or show weather damage it may be left in the fields unthreshed much longer than cereals.

Because many factors enter into the successful combining of flax, experts suggest that it is not easy to outline definite adjustments and procedures. Aside from the different threshing action needed for some varieties, these factors include varying harvest weather conditions, changes in the humidity of the air and the way the crop has matured—all of which may call for changes and adjustments several times daily if threshing is to be done without damaging the seed. Two general rules, however, should be mentioned:

(1) **Flax should not be threshed until moisture content is down to 10.5%,** unless because of unfavorable weather late in the fall, it becomes absolutely necessary to proceed with the harvest.

(2) **No attempt should be made to do a "Seed" job with the combine.** If a heavy, really clean sample is obtained, it almost always carries with it a large percentage of damaged seeds. Flax is easily injured in threshing and cracked or scratched seed, even though invisible to the eye, permits the entry of some form of mould. Broken and chipped kernels, too, cause trouble in processing. Cylinder speed and concave clearances are all important in minimizing damage of this kind.

CYLINDER SPEED AND CLEARANCE

Cylinder speed should be in the same range as that required for threshing wheat, that is, the tip of the cylinder bars or teeth should run at approximately 6200 feet per minute. Speed should be kept to a practical minimum, however, to reduce the danger of damaging the seeds and at the same time to obtain the desired degree of threshing. When rubber rolls are used, the cylinder speed may be reduced to as low as 5800 feet per minute at the circumferences. Authorities suggest that the bar type of cylinder has generally proven superior to the tooth type for threshing all oil seed crops, including Flax.

Clearance between the concaves and the cylinder at the front should be approximately half that required for wheat, ranging from 1/8 to 1/4 or even 5/16 of an inch, depending upon threshing conditions. The rear clearance, also adjusted according to threshing conditions, may range from 1/16 to 1/8 of an inch. The object should be to have the concave clearance set up close enough to break the flax bolls in the first pass through. Shredding of the straw, breaking of the kernels, large amounts of broken straw in the grain or a heavily overloaded shoe usually indicate insufficient clearance resulting in too severe a threshing action. On the other hand, unbroken bolls, or a heavy return of bolls not stripped from the straw indicate too much clearance.

OTHER ADJUSTMENTS

The separation of large amounts of chaff from the seeds is difficult. The wind blast from the fan should be reduced to considerably less than that required for the cleaning of wheat. This may be done by either reducing the fan speed or closing the air intake shutters on the fan housing, or a combination of both.

The chaffer sieve should be as wide open as possible to allow the maximum quantity of grain to pass through, thus preventing a heavy return. The wind board located behind the fan in most combines, should be set to direct the air blast well towards the front of the shoe so that all flax and chaff will be lifted off the chaffer surface. Sufficient air blast will then be available on the back 2/3 of the shoe to float the chaff over the tailings grate yet permit the separated grain to fall onto a clean chaffer surface and pass through to the grading or cleaning sieve.

The final cleaning sieve in the shoe may be an adjustable sieve or a round hole non-adjustable type, depending on the type of the combine. The adjustable type sieve should be nearest to the point where it will allow the flax seed to pass through and will float unbroken or partially broken bolls and short stems over into the return auger for re-threshing. The non-adjustable type should be a 9/64 to 3/16 inch diameter round hole sieve, depending on the plumpness of the flax.

Grades

Flaxseed carries 4 statutory grades, details of which are given below

STATUTORY GRADES

STANDARD OF QUALITY

FLAXSEED

	MIN. WGHT PER BUS.	SOUNDNESS	STANDARD OF CLEANNESS
1 C.W.	51	Matured and sweet. May contain 12½% damaged seeds, including broken seeds.	Clean, commercially pure seed.
2 C.W.	50	Matured and sweet. May contain 25% damaged seeds, including broken seeds.	Clean, commercially pure seed.
3 C.W.	47	May contain 5% heat damage.	Clean, commercially pure seed.
4 C.W.	44	May contain 10% heat damage.	Clean, commercially pure seed.

Flaxseed weighing less than 44 lbs. per bushel will grade **"Sample C.W. Flaxseed a/c light weight."**

GRADING FACTORS

Percentage of Moisture Allowed in Straight, Tough or Damp Grain

Straight Grade: Up to 10.5%.
Tough: 10.6% to 13.5%.
Damp: Over 13.5%.

Sample Flax:

1 C.W. and 2 C.W. containing up to 5% heated, grades 3 C.W.

1, 2 and 3 C.W. containing up to 10% heated, grades 4 C.W.

All flaxseed that does not qualify for a statutory or commercial grade or an off-grade, is graded as "Sample" with the addition of words to indicate damage or admixtures.

Off Grades

All Western flaxseed containing excessive inseparable admixture, but not in excess of two and one-half percent of shrunken or broken grain or weed seeds or any combination thereof, shall be graded according to the statutory or commercial grade that would otherwise apply to it, except that there shall be added to and made part of the grade name the words **"Rejected — Account Admixture".**

Inseparable Seeds and/or Broken Grain

Grades 1 C.W., 2 C.W., 3 C.W. and 4 C.W. may contain up to 1%, to be assessed as additional dockage.

When containing over 1% of such admixtures, up to 3½%, grade **Rejected (to grade).**

Account Admixture, with dockage for the excess over 2½%.
Over 3½%, including not over 1% inseparable seeds, grade **Flax & Broken Grain.**

Over 3½%, including over 1% inseparable seeds, grade **Flaxseed, Sample C.W. Account Inseparable Seeds.**

Cereal Grain Admixtures

Flax containing 2½% and over of cereal grain or mixture of cereal grain, grades M.S. (Machine Separation). Wild oats in flax are classed as dockage.

Flaxseed Containing False Flax

1 C.W.	may	contain	5%	False	Flax
2 C.W.	"	"	10%	"	"
3 C.W.	"	"	15%	"	"
4 C.W.	"	"	25%	"	"
"Sample"	when	over	25%	"	"

Storing

Flax is one crop which cannot be stored safely if the moisture content is high; that is, over 10.5%. If the moisture is above this level, it will pay to clean the flax and to remove all foreign moisture and weed seeds. This will help to reduce the moisture content considerably but it will still be advisable to examine the flax very carefully, from time to time, for indications of heating.

Some General Observations

Little attempt has been made in this bulletin to discuss such matters as the place of flax in the rotation or to go into any detail about cultural practices. These are matters which are related to soil, rainfall, weed control problems, the type of crops best suited to the area and other factors. The local District Agriculturist or authorities at the nearest Experimental Farm are in a better position to discuss these matters with the individual producer.

In general, however, it may be said that flax will fit into almost any cropping program and that it may prove useful in a rotation for at least two reasons. First, it is fairly free of disease and for this reason it offers a good alternative to other crops; and second, it has long been accepted as the best nurse or companion crop for a new seedling of legumes and grasses.

The average yield of flax for the prairie provinces, during the past 25 years, is 8.5 bushels per acre, or approximately half that of wheat. There have been occasions in recent years, as in 1957, when, because of the "aster yellow" disease and drouth, the average yield in the prairie provinces was only 5.7 bushels per acre and that for Manitoba as low as 4 bushels per acre. However, yields have been generally favourable and, as long as the outlook for the marketing and sale of flax remains good, it is probable that the interest in this crop will be well maintained. As a reliable 'cash' crop, flax appears to have gathered strength in recent years and, generally speaking, it has given a very good account of itself.

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